CLAIMS:

What is claimed is:

1. A semiconductor device for production of a gas when the semiconductor device is both suspended in a material containing the gas and exposed to light, the semiconductor device comprising:

   a. a substrate;

   b. a photoactive semiconductor top layer further comprising a photoelectrochemical electrode junction at an interface formed with a material containing a gas in which the semiconductor device is suspended;

   c. a first semiconductor layer disposed on the substrate intermediate the substrate and the photoactive semiconductor top layer; and

   d. an interface layer disposed intermediate the first semiconductor layer and the photoactive semiconductor top layer.

2. The semiconductor device of claim 1 wherein the substrate comprises at least one of (i) stainless steel, (ii) coated glass, (iii) nickel, (iv) titanium, or (v) coated plastic.

3. The semiconductor device of claim 1, wherein the first semiconductor layer disposed on the substrate comprises a plurality of semiconductor layers.

4. The semiconductor device of claim 3, wherein the plurality of semiconductor layers comprise a photovoltaic junction.

5. The semiconductor device of claim 3, wherein the first semiconductor layer disposed on the substrate further comprises at least one of (i) amorphous silicon, (ii) amorphous germanium, (iii) amorphous silicon-germanium, (iv) microcrystalline silicon, (v)

microcrystalline germanium, (vi) microcrystalline silicon-germanium or (vii) copper-indium-gallium-diselenide.

6. The semiconductor device of claim 3 further comprising a reflector layer disposed intermediate the substrate and the first semiconductor layer.

7. The semiconductor device of claim 1, wherein the photoactive semiconductor top layer disposed on the substrate further comprises at least one of (i) TiO_2, (ii) WO_3, or (iii) Fe_2O_3.

8. The semiconductor device of claim 1, wherein the photoactive semiconductor top layer exhibits strong integrated optical absorption in the 300-500 nm range.

9. The semiconductor device of claim 1, wherein the interface layer further comprises a conductive-transparent oxide (CTO).

10. The semiconductor device of claim 9, wherein the CTO further comprises at least one of (i) indium tin oxide (ITO) or (ii) tin oxide (SnO).

11. The semiconductor device of claim 1, further comprising a catalyst layer disposed on a surface of the substrate opposite the first semiconductor layer disposed on the substrate.

12. The semiconductor device of claim 11 wherein the catalyst layer further comprises a surface catalyzed for the hydrogen evolution reaction (HER), the catalyst layer further comprising at least one of (i) a non-platinum metal, (ii) a mix of metals or (iii) platinum.

13. A method of creating a photoelectrode adapted to liberate a gas present in a material using incident light, comprising:

a. fabricating a first semiconductor layer onto a substrate to form a contact interface between the first semiconductor layer and the substrate, the contact interface comprising an electrical contact with the substrate;

b. fabricating an interface layer onto a surface of the first semiconductor layer opposite the contact interface with the substrate; and

c. fabricating a photoactive semiconductor layer onto the interface layer.

14. The method of claim 13, further comprising fabricating the first semiconductor layer as a plurality of semiconductor layers.

15. The method of claim 14, wherein the plurality of semiconductor layers form a photovoltaic junction.

16. A method of producing a gas from a material containing constituent materials of the gas, comprising:

a. placing a semiconductor device for production of a gas into a material containing constituent materials of the gas, the semiconductor device comprising a substrate; a first semiconductor layer disposed on the substrate; a photoactive semiconductor top layer further comprising a photoelectrochemical electrode junction; and an interface layer disposed between the semiconductor layer and the photoactive semiconductor top layer; and

b. exposing a surface of the photoactive semiconductor top layer to both a source of light and the material.

17. The method of claim 16, wherein:

a. the source of light is the sun;

b. the material is a liquid electrolyte; and

c. the gas is at least one of (a) hydrogen or (b) oxygen.